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Improving Raw Milk Procurement Performance Through Process Mapping and Bottleneck Analysis: A Case Study of Parag Milk Foods Ltd.

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Abstract **- Raw milk procurement is a time-sensitive supply-chain activity in which quality depends on coordinated collection, rapid chilling, reliable transport, accurate testing, and timely information exchange. This paper examines the raw milk procurement process at Parag Milk Foods Ltd. using an internship-based descriptive and exploratory case study drawing on process observations, discussions with operations and supply-chain personnel, process walkthroughs, and secondary material. The process is mapped from village-level collection to farmer payment, and potential bottlenecks are assessed at stage interfaces. The main issues identified are cold-chain time/temperature exposure, inconsistent testing practices, delayed feedback from plant quality control to collection centres, tanker scheduling misaligned with plant intake, seasonal mismatch between fixed chilling capacity and variable supply, and payment-related information delays. A qualitative prioritisation indicates that cold-chain integrity and information flow warrant early attention. The paper specifies seven interventions (equipment calibration, mobile data capture, integrated tanker scheduling, time-bound rejection feedback, flexible chilling capacity, payment-cycle review, and clearer communication of quality-linked pricing) and supplies a twelve-month roadmap, a metric dictionary, a pilot-evaluation design, and a risk register. Because the original study rests on purposive observations during a limited internship period, the findings are directional rather than statistically generalisable; all numerical priority scores are illustrative analytical judgements, not measured operational data.**

Keywords **-** *Dairy supply chain, raw milk procurement, process mapping, bottleneck analysis, cold chain, digital procurement, farmer payment*

I. INTRODUCTION

Dairy procurement differs from conventional industrial purchasing because its primary input is perishable, geographically dispersed, and collected in frequent small lots. Raw milk quality can deteriorate if cooling is delayed, while its composition and acceptability must be checked before processing. Procurement performance therefore depends not only on price and supplier availability but also on the coordination of collection points, chilling centres, tankers, plant reception, quality control, production planning, and farmer payment.

In the Indian dairy context, supply is commonly drawn from many small producers who deliver modest quantities at short intervals. This places a heavy burden on the collection and chilling network that sits between the farm gate and the processing plant: the network must preserve quality, record what was delivered, and settle accounts with each supplier, all within a short time window.

Parag Milk Foods Ltd. is a private dairy business headquartered in Pune, with major processing operations at Manchar, Maharashtra, and Palamaner, Andhra Pradesh. The source internship report [1] describes a multi-state procurement footprint across Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu, supported by thousands of village collection centres and more than one hundred chilling centres or bulk milk coolers. These scale indicators are reported in the source document and should be treated as approximate, as network figures can vary by reporting period.

Problems in such a network are rarely confined to one function. A delay at the collection centre becomes a temperature problem at the chilling centre, a queue at the plant gate, a rejection at reception and, finally, a payment query from the farmer. Because these consequences appear in different departments and at different times, they are easily attributed to the wrong cause. A process-level view that follows both the milk and the information about the milk is therefore needed.

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The purpose of this paper is to convert the internship report's process description into a research-paper format, identify recurring coordination risks, and present actionable improvement opportunities. It addresses three questions: (1) How does raw milk move from farmers to plant intake and payment? (2) Where do operational and information bottlenecks arise? (3) Which practical interventions should be prioritised, and how should they be implemented and evaluated? The paper does not claim to be a company-wide audit or a causal statistical study.

The paper makes three contributions. First, it documents the procurement sequence together with its critical controls and records. Second, it locates bottlenecks at stage interfaces and attaches to each a validation test, so that plausible causes can be confirmed or rejected with operational data. Third, it converts the findings into a phased roadmap, a metric dictionary, and a pilot-evaluation design that the company could execute, while stating clearly which data are still missing.

Section II reviews the conceptual background. Section III sets out the research design. Section IV describes the existing process and Section V analyses its bottlenecks. Section VI prioritises improvements, Section VII specifies the proposed interventions, and Section VIII presents the roadmap, metrics, and risks. Sections IX–XI cover discussion, limitations, and conclusions.

II. LITERATURE REVIEW AND CONCEPTUAL BACKGROUND

A. *Perishability and Fragmented Sourcing*

Dairy supply-chain literature emphasises the combined effects of perishability and fragmented sourcing. Unlike many industrial materials, raw milk cannot be held for long without temperature control. Delays at collection, transfer, or transport can affect quality and shelf life, making the first-mile collection network and downstream processing capacity tightly interdependent [1]. Reviews of food distribution argue that quality decay, and not only cost, should be an explicit planning objective, and that routing, scheduling, and capacity decisions interact [2]. Hygienic-practice guidance for milk likewise treats handling, cooling, and the interval between production and processing as control points rather than incidental details [3].

B. *Quality Testing and Quality-Linked Payment*

Quality assurance at collection commonly includes measurement of fat and solids-not-fat (SNF), basic adulteration screening, and appropriate handling. When payment is linked to tested composition, transparent testing and clear communication are important: inconsistent equipment calibration or poorly explained deductions can weaken trust even when the payment formula itself is sound [1]. Testing therefore serves two functions. It protects the plant from unacceptable raw material, and it generates the price signal on which the farmer's income depends. When one reading serves both purposes, measurement error is transmitted directly into supplier trust, so operator practice, calibration, sample handling, and record-keeping matter as much as the formula.

C. *Cold Chain and Logistics Coordination*

Cold-chain and logistics coordination are similarly central. Collection schedules, chilling capacity, tanker availability, road conditions, and plant intake windows need to be planned as a connected system. If each stage schedules independently, a locally efficient decision can create downstream queues, temperature exposure, or underutilised equipment. For a product that cannot be stored, waiting time is the most damaging form of buffer; joint planning of collection, chilling, dispatch, and intake is the logistics expression of that principle.

D. *Process Mapping and Constraint Thinking*

Process mapping makes the sequence of activities and hand-offs visible and separates value-adding steps from waiting and rework; value-stream mapping extends this by following information as well as material [4]. The Theory of Constraints adds that system performance is governed by its most limiting element, and that improving non-constraints may leave overall performance unchanged [5]. In a procurement chain this directs attention to the interfaces (hand-offs, queues, and data transfers) and not only to the capacity of individual stages. Cause-and-effect analysis [6] then helps distinguish symptoms from plausible root causes under headings such as method, measurement, equipment, people, and environment.

E. *Information Flow and Digitisation*

Digitisation can reduce the delay between a physical event and the point at which decision-makers see it. Mobile capture of volume, quality readings, timestamps, and rejection reasons can improve traceability and support faster corrective action. However, technology alone is insufficient where connectivity, staff capability, data standards, or process ownership are weak. Delayed or aggregated signals are known to distort decisions upstream in supply chains [7]; the perishable-chain analogue is a rejection result that reaches the collection centre after the next day's milk has already been handled in the same way. Traceability research stresses that recording identity, quantity, quality, and time at each transfer is a precondition for both safety assurance and learning [8].

F. *Research Gap*

The source report identifies a gap in company-specific operational analysis of listed private dairy firms. Studies of quality, logistics, and information systems tend to treat these topics separately, and case evidence that follows one company's raw milk from village to payment is limited. This case study offers a bounded, practice-oriented contribution rather than a broad sector generalisation.

III. RESEARCH DESIGN AND METHODOLOGY

A. *Objectives*

The study has four objectives: to document the raw milk procurement sequence; identify potential bottlenecks and cross-functional coordination gaps; prioritise improvement opportunities using qualitative impact and feasibility judgements; and propose an implementation roadmap that can be validated with operational data.

B. *Design*

A descriptive-exploratory case-study design was used in the underlying internship report. Case studies suit "how" and "where" questions about a bounded, real-world setting whose conditions the investigator cannot manipulate [9]. The case here is the raw milk procurement function of one company. The aim is analytic, namely a structured account that guides validation, and not statistical generalisation.

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C. Data Sources and Sampling

Primary inputs included direct observation of collection, procurement, and plant-intake activities; discussions with the company guide and operational personnel; and process walkthroughs where access permitted. Secondary inputs included company information, industry commentary, and literature on dairy supply chains and process improvement (Table I). The internship period stated in the source report was 25 May–25 July 2026.

Sampling was purposive rather than statistically representative. Purposive sampling selects information-rich settings but does not support inference to a wider population [10]. The observed locations and discussions cannot be assumed to represent every centre or all four sourcing states. Seasonal effects were discussed using staff inputs and secondary context rather than direct observation across a full flush and lean cycle. Accordingly, findings are presented as potential or indicative bottlenecks. No measured rejection rates, spoilage rates, transit-time distributions, cost savings, or farmer-payment performance figures were supplied in the source report; none are invented here.

TABLE I. DATA SOURCES AND THEIR LIMITS

Source	Use in the study	Main limitation
Direct observation	Sequence, hand-offs, controls	Short window; selected sites
Discussions with guide and staff	Causes, practices, seasonality	Perceptions, not measurements
Process walkthroughs	Confirming sequence and records	Dependent on access
Company and industry material	Scale and context	Figures approximate
Literature	Concepts and framing	Not company-specific

D. Analytical Procedure

Analytical steps were: (i) map the physical and information flows; (ii) identify hand-off points; (iii) connect observed symptoms with plausible causes; (iv) rank issues qualitatively by operational consequence; and (v) evaluate improvements for expected impact, feasibility, and implementation horizon.

E. Qualitative Scoring

Two judgement scales are used. Bottleneck priority is scored on a five-point scale (1 = lower, 5 = highest) reflecting consequence for product quality, traceability, and speed of corrective action. Interventions are rated for expected impact and feasibility with ordinal labels; for plotting only, the labels are placed on a numeric axis (Low–Medium 1.5, Medium 2, Medium–High 2.5, High 3). These scales are illustrative judgement scales, not measured KPIs, and readers can replace them with validated ratings, for example from a structured expert panel.

F. Credibility and Ethics

Credibility rests on triangulating observation, discussion, and documents; on labelling every uncertain claim as potential; and on supplying a validation test for each bottleneck. No farmer-level or personal data are used. Commercially sensitive claims should be reviewed by the company before external publication.

IV. EXISTING PROCUREMENT PROCESS

A. Overview

The procurement process can be represented as seven linked activities, shown in Fig. 1. Farmers deliver milk to village collection centres, where volume and basic quality readings are recorded. Aggregated milk moves to a chilling centre or bulk milk cooler. Chilled milk is dispatched by insulated or refrigerated tanker to the processing plant, where quality is checked again. Accepted milk is transferred to silos and released to production planning. Recorded volume and quality data then support farmer payment, typically on a defined payment cycle.

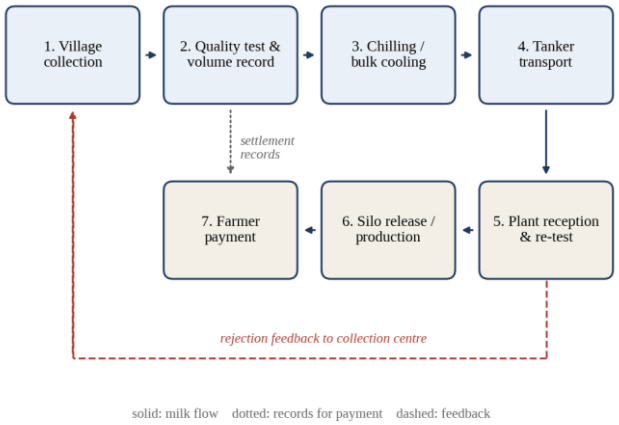


Fig. 1. End-to-end raw milk procurement process, showing milk flow, settlement records, and the rejection-feedback loop (schematic).

B. Village Collection and Testing

At village collection, the critical controls are accurate farmer identification, volume recording, fat/SNF measurement, and basic screening. The records created here (identity, quantity, readings, time of receipt) are the foundation for every later decision, including payment, so errors at this stage propagate through the whole chain.

C. Chilling

At chilling, the main controls are temperature reduction, holding conditions, and equipment availability. The interval between collection and the start of cooling is the first point at which quality can be lost, and it is determined partly by distance, road conditions, and collection frequency.

D. Tanker Transport

During transport, routing, dispatch timing, transit time, and cold-chain integrity become important. Tanker trip details (departure and arrival times, quantity, and temperature where recorded) link the chilling stage to plant reception and are the main evidence for diagnosing waiting or temperature exposure.

E. Plant Reception, Silo Release, and Payment

At plant reception, retesting and the accept/reject decision affect both raw-material availability and supplier settlement. Accepted milk is transferred to silos and released to production planning, so intake timing shapes the production schedule. The

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payment stage closes the loop between physical delivery, quality results, and farmer remuneration.

F. Information Flow

The physical movement of milk is accompanied by an information flow: collection readings, timestamps, accepted and rejected quantities, tanker trip details, plant retest results, and farmer ledgers (Table II). A key process risk occurs when these flows become disconnected. For example, a plant rejection that is not communicated promptly to the originating collection centre cannot support timely correction in handling or testing practices.

TABLE II. CRITICAL CONTROLS AND RECORDS BY STAGE

Stage	Critical controls	Key records
Collection	Farmer ID; volume; fat/SNF; basic screening	Identity, quantity, readings, time
Chilling	Temperature reduction; holding; equipment availability	Arrival, temperature, dispatch time
Transport	Routing; dispatch timing; transit time; cold chain	Trip details, times, temperature
Plant reception	Retest; accept/reject decision	Retest results; accepted/rejected quantity; reason
Silo / planning	Transfer; release to production	Intake and silo records
Payment	Reconciliation; disbursal	Ledger; quality-linked statement

V. BOTTLENECKS AND ROOT-CAUSE ANALYSIS

A. Interface Perspective

The source report identifies potential bottlenecks across the process, with several risks concentrated at stage interfaces rather than within a single function. Following the constraint logic in [5], the analysis therefore examines hand-offs, queues, and data transfers. Table III summarises the principal issues, plausible root causes, and, for each, a validation test that would confirm or reject the explanation. The descriptions are indicative and require validation through broader operational sampling.

B. Inconsistent Testing

Inconsistent testing may arise from differences in analyser calibration, maintenance, operator training, or local procedures. The consequence is not only a quality-control risk but also the possibility of disputes when collection-centre results differ from plant retesting. A central calibration log, standard operating procedures, and periodic cross-checks would help separate actual milk-quality variation from measurement variation.

C. Cold-Chain Exposure

Collection-to-chilling delays and transport temperature excursions may result from remote collection locations, road and terrain constraints, insufficient collection frequency, or tanker schedules that are not aligned with actual volume and plant intake. Since milk is perishable, cold-chain integrity is the highest-consequence physical risk. Monitoring should focus on elapsed time to chilling, temperature records, route exceptions, and waiting time before unloading.

D. Plant-Gate Queues

Plant-gate queues may occur when several tankers arrive in a narrow time window or when dispatch is not linked to silo availability and production plans. This is an end-to-end scheduling problem: optimising the route or dispatch decision independently may simply move the queue elsewhere. Shared planning between logistics, procurement, quality control, and production is therefore required.

E. Delayed Information Feedback

Manual or semi-digitised records can delay the flow of quality results and rejection reasons to upstream centres. The delay weakens root-cause correction and can create uncertainty in farmer payment. A time-bound feedback loop and common data fields would improve accountability.

F. Seasonal Capacity Mismatch

Fixed chilling infrastructure may be underutilised in lean periods and strained during flush-season peaks. Flexible capacity should be evaluated against seasonal volumes, utilisation, and the cost of quality loss.

G. Payment-Cycle Delay

Payment-cycle delays or disputes may reflect lags between collection, testing, reconciliation, and disbursal. The source report describes quality-linked farmer payment and digital transfer as relevant practices, but does not provide payment-delay statistics. The appropriate first step is therefore to measure cycle time and dispute frequency, not to assume a quantified problem.

H. Interactions Among Bottlenecks

The bottlenecks reinforce one another. Inconsistent testing and delayed feedback combine badly: if a plant retest differs from the centre's reading and the result arrives late, the centre cannot learn whether the cause was the instrument or the milk. Cold-chain exposure raises the likelihood of rejection, whose usefulness then depends on how quickly it is communicated. Payment disputes are the downstream expression of both. This clustering is the reason information flow is treated as a co-priority with cold-chain integrity in Section VI.

TABLE III. INDICATIVE BOTTLENECKS, CAUSES, AND VALIDATION TESTS

Interface / bottleneck	Plausible root cause	Operational implication	Validation test
Collection: inconsistent readings	Calibration or training variation	Disputes; unreliable quality signals	Split-sample test at centre and plant
Collection → chilling: delay before cooling	Distance, roads, collection frequency	Quality deterioration risk	Time from collection to chilling, by centre
Chilling / transport: temperature excursion	Capacity or dispatch mismatch	Quality loss; higher rejection risk	Excursions per trip, by route

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Interface / bottleneck	Plausible root cause	Operational implication	Validation test
Transport → plant: gate queue	Tanker arrivals not aligned to intake	Waiting time; cold-chain exposure	Arrival-time distribution; waiting time
Information flow: delayed rejection feedback	Manual or semi-digital records	Slow corrective action	Time from rejection to centre confirmation
Payment: delay or disputes	Testing-to-ledger reconciliation lag	Lower trust; supplier-retention risk	Cycle time; dispute log

VI. PRIORITISATION OF IMPROVEMENTS

A. *Bottleneck Priority*

Cold-chain integrity and information flow are prioritised because they have direct implications for product quality, traceability, and the speed of corrective action. Payment-cycle transparency is also important for farmer relations and supplier retention. Fig. 2 uses a qualitative five-point scale to communicate relative judgement; the values are not survey results or company KPIs. The ordering reflects consequence rather than observed frequency, which the source report does not quantify.

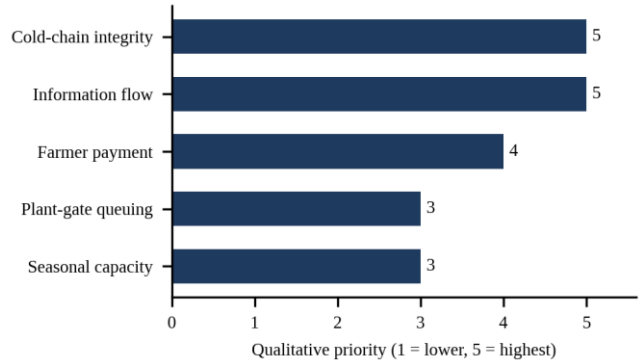


Fig. 2. Qualitative priority scores (1 = lower, 5 = highest); author-assigned for discussion, not measured company data.

B. *Intervention Portfolio*

The strongest early actions are those that improve process discipline without requiring large capital investment: calibrate testing equipment, digitise critical collection data where feasible, and formalise plant rejection feedback. These interventions improve the reliability of the information used for later decisions. Scheduling alignment is a next-stage action because it requires coordination across multiple departments and potentially changes to dispatch routines. Flexible or mobile chilling capacity is a longer-term option requiring demand analysis and a financial case.

Table IV presents the proposed intervention set and Fig. 3 plots it on the impact-feasibility plane. Feasibility is expressed qualitatively, based on the source report's impact-feasibility assessment. Interventions 1, 2, and 4 combine high expected impact with at least medium feasibility; intervention 5 has potentially high impact but lower feasibility and is therefore sequenced later. Actual investment decisions should follow a pilot, baseline measurement, and cost-benefit analysis.

TABLE IV. PROPOSED IMPROVEMENT PORTFOLIO

#	Intervention	Impact	Feasibility	Timing
1	Calibrate analysers; maintain central log	High	Medium	0–3 months
2	Mobile capture of volume, fat/SNF, time	High	Medium	3–6 months pilot
3	Link tanker dispatch to plant intake / silos	Medium–High	Medium	3–6 months design; 6–12 operation
4	Rejection feedback within 24–48 hours	High	High	0–3 months
5	Assess modular / mobile chilling	Potentially high	Low–Medium	6–12 months
6	Review payment cycle and digital transfer	Medium	Medium	3–6 months
7	Explain quality-linked pricing to farmers	Medium	High	Ongoing

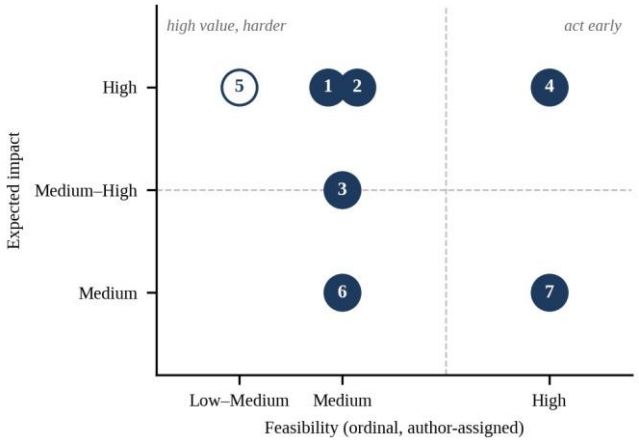


Fig. 3. Impact–feasibility plane for the seven interventions (numbers as in Table IV; hollow marker = impact stated as "potentially high"). Ordinal, author-assigned positions.

VII. PROPOSED INTERVENTIONS

1) Calibration and central log. Each analyser would have a calibration register recording date, reference check, operator, result, and corrective action. Periodic cross-checks, in which the same sample is tested at a collection centre and at the plant, would separate measurement variation from real quality variation. Standard operating procedures should cover sample handling. Quality control would own the register.

2) Mobile data capture. Farmer identity, volume, fat/SNF readings, timestamps, and rejection codes would be captured at the point of collection using common data fields. Because rural connectivity is uneven, the pilot must support offline capture

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with later synchronisation. Training and simple procedures matter as much as the application itself.

3) Integrated tanker scheduling. Collection centres and logistics would share expected volumes and dispatch times with the plant, while the plant shares intake windows and silo availability. A manually maintained daily plan with a short exception review can precede any software. The objective is to stagger arrivals and cut waiting time without moving the queue elsewhere.

4) Time-bound rejection feedback. Rejection decisions would use standard reason codes and be communicated to the originating centre, and to procurement, within 24–48 hours, including retest values. Quality control would own the loop, and cases exceeding the limit would be escalated.

5) Flexible chilling capacity. Modular or mobile chilling units would be assessed against the seasonal volume profile, utilisation, and the cost of quality loss. No commitment should precede a seasonal capacity review, because the case rests on demand data that the source report does not provide.

6) Payment-cycle review. The steps from testing to ledger entry to disbursal would be mapped, cycle time and dispute frequency measured, and reconciliation lags located. Any shortening of the cycle should first be assessed for working-capital effects.

7) Communication of quality-linked pricing. Farmers would be shown their readings at the time of collection and given a simple statement explaining how readings translate into payment and how deductions arise, with a channel for questions. Because disputes often stem from poorly explained deductions [1], this low-cost action supports the others.

VIII. IMPLEMENTATION ROADMAP AND PERFORMANCE MEASUREMENT

A. Phased Roadmap

A phased rollout reduces implementation risk (Fig. 4). In the first 0–3 months, the company can standardise testing procedures, create a calibration register, define rejection-feedback ownership, and establish baseline metrics. In months 3–6, selected centres can pilot mobile capture of volume, fat/SNF readings, timestamps, and rejection codes, with offline capture or synchronisation where connectivity is unreliable; the dispatch-to-intake linkage is designed in the same period. In months 6–12, tanker dispatch is operated against plant intake windows and silo availability, while a seasonal capacity review tests the business case for modular chilling.

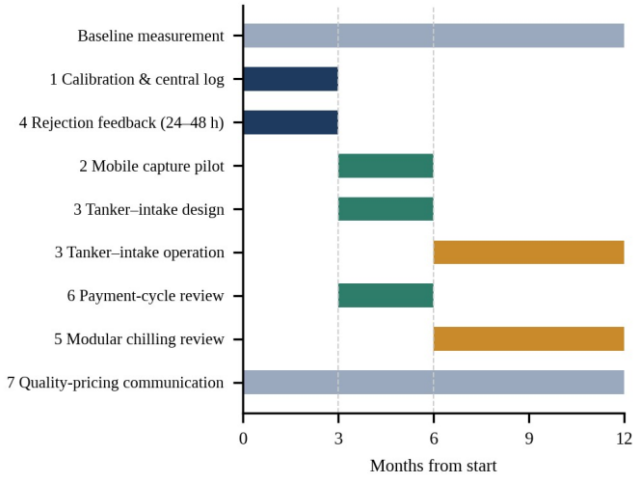


Fig. 4. Indicative twelve-month roadmap (numbers as in Table IV).

B. Performance Metrics

Performance measurement should begin before intervention. Suggested metrics are defined in Table V. The source report does not provide baseline values, so targets should be set only after a representative measurement period and agreement on definitions.

TABLE V. METRIC DICTIONARY

Metric	Definition	Owner
Time to chilling	Elapsed time from collection to start of chilling, by centre	Collection / chilling
Timestamp completeness	Share of readings with complete timestamps	Collection centres
Calibration compliance	Share of analysers calibrated on schedule	Quality control
Rejection rate by source	Rejected over received quantity, per source centre	Quality control
Rejection communication time	Median time from rejection to confirmed receipt at centre	Quality control
Tanker waiting time	Median time from gate arrival to unloading start	Logistics
Temperature excursions	Readings outside the agreed limit, per trip	Logistics
Payment-cycle duration	Days from collection to disbursal	Procurement / finance
Payment disputes	Disputes raised per period, per centre	Procurement / finance

C. Governance

Governance should assign a process owner to each metric. Collection-centre operators should own first-mile data quality; quality control should own calibration and rejection coding; logistics should own route and tanker performance; production planning should provide intake windows; and procurement/finance should jointly monitor farmer settlement. A weekly exception review and monthly trend review can convert the dashboard from a reporting tool into a corrective-action mechanism.

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D. Pilot Evaluation Design

Pilot centres should be chosen to span different distances and sizes, with a comparable group of non-pilot centres where practical. Baseline measurement should cover a representative period, ideally including both flush and lean conditions, using the definitions in Table V. Changes in pilot centres would be compared with changes in the comparison group, and results reported with caution given small samples. Qualitative feedback from farmers and collection-centre staff should accompany the metrics, and the decision rule for scaling up should be agreed before the pilot begins.

E. Implementation Risks

Table VI lists the main implementation risks with proposed mitigations. These are qualitative judgements.

TABLE VI. IMPLEMENTATION RISKS AND MITIGATIONS

Risk	Mitigation
Connectivity gaps	Offline capture with later synchronisation
Staff adoption	Training, simple procedures, supervisor support
Inconsistent master data	Common farmer and centre identifiers
Capital constraints	Start with low-capital actions (1, 4, 7)
Working-capital effects	Finance assessment before shortening payment cycles
Unclear ownership	Named metric owners; weekly exception review

IX. DISCUSSION

The case illustrates that procurement performance is not determined by any single asset or department. Collection-centre testing can be technically adequate yet still generate disputes if instruments are not calibrated consistently. Chilling capacity can be sufficient in aggregate but ineffective if transfer timing and tanker availability are poorly coordinated. A digital dashboard can improve visibility but will not resolve delays unless responsibilities, escalation rules, and corrective actions are explicit.

The central managerial implication is to improve the interfaces first. Standard data fields and timestamps make events traceable; time-bound rejection feedback turns quality control into learning; and integrated dispatch planning aligns physical flows with plant constraints. These steps can be piloted before committing to higher-cost infrastructure. The findings are consistent with constraint thinking [5] and with the information-delay argument in [7], although this study cannot test either empirically. The company's broader scale and value-added product ambitions make procurement reliability strategically relevant, but the current study cannot quantify the financial return from these interventions.

Implementation risks include connectivity gaps, staff adoption, inconsistent master data, capital constraints, and potential working-capital effects from shortening payment cycles. Change management should include training, simple procedures, named owners, and feedback from farmers and collection-centre personnel. The interactive element of this paper is its use of linked section navigation and clickable references in the PDF, plus an editable Word version for readers to annotate, update the qualitative scores, and replace proposed metrics with validated company data. These tools support review and iteration; they do not imply that the underlying findings have been independently verified.

X. LIMITATIONS AND FUTURE RESEARCH

This paper inherits the limitations of the underlying internship report: a short observation window, purposive access to selected operations, reliance on qualitative discussions, and limited visibility into confidential operational data. The observer's position as an intern may also have shaped what was visible. The paper does not establish causal relationships or statistically generalisable estimates. The bottlenecks are described as potential or indicative, and the prioritisation scores are analytical judgements that other assessors might rate differently.

Future work should measure operational performance across multiple seasons and locations. A before-and-after evaluation could compare rejection rates, time to chilling, tanker waiting time, temperature excursions, payment-cycle duration, and disputes. Further studies could compare districts or procurement models, examine the economics of mobile chilling, and assess farmer adoption of digital quality and payment records. Such research would test whether the recommended interventions create measurable gains.

XI. CONCLUSION

Raw milk procurement at Parag Milk Foods Ltd. is a multi-stage process in which product quality and operational efficiency depend on the coordination of collection, chilling, transport, plant reception, information exchange, and farmer payment. The internship-based analysis points to cold-chain exposure, inconsistent testing, delayed information flow, tanker scheduling, seasonal capacity mismatch, and payment reconciliation as potential areas for improvement. The most practical starting point is to strengthen testing discipline and information feedback, then improve integrated scheduling and evaluate flexible capacity using measured data. A phased, metric-led implementation, evaluated against baselines, would allow the company to validate benefits while managing cost, connectivity, and adoption risks. The paper's contribution is a structured operational framework for further testing, rather than a claim of measured performance improvement.

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